

**METHODS FOR FORMING ROUGH RUTHENIUM-CONTAINING  
LAYERS AND STRUCTURES/METHODS USING SAME**

**Abstract of the Invention**

5 A method for forming a rough ruthenium-containing layer on the surface of a  
substrate assembly includes providing a ruthenium-containing precursor into the  
reaction chamber. A rough ruthenium layer may be deposited on the surface of the  
substrate assembly at a rate of about 100 Å/minute to about 500 Å/minute using the  
ruthenium-containing precursor. Further, a rough ruthenium oxide layer may be formed  
10 by providing a ruthenium-containing precursor and an oxygen-containing precursor into  
the reaction chamber to deposit the rough ruthenium oxide layer on the surface of the  
substrate assembly at a rate of about 100 Å/minute to about 1200 Å/minute. An anneal  
of the layers may be performed to further increase the roughness. In addition,  
conductive structures including a rough ruthenium layer or a rough ruthenium oxide  
15 layer are provided. Such layers may be used in conjunction with non-rough ruthenium  
and/or non-rough ruthenium oxide layers to form conductive structures. For example,  
such structures may be part of a capacitor structure, e.g., bottom electrode of a  
capacitor.

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